SIXTEENTH ANNUAL REPORT

OF THE

South Carolina Experiment Station,

OF THE

CLEMSON AGRICULTURAL COLLEGE,

FOR THE YEAR ENDING

JUNE 30, 1903.

COLUMBIA, S. C.
THE STATE COMPANY.
1904.

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———————, *Dairyman and Animal Husbandman.*
HAVEN METCALF, A. M., Ph. D., *Botanist and Bacteriologist.*

F. S. SHIVER, Ph. G., *Assistant Chemist.*
R. N. BRACKETT, Ph. D., *Assistant Chemist.*
*C. C. MCDONNELL, B. S., *Assistant Chemist.*
*B. F. ROBERTSON, B. S., *Assistant Chemist.*
D. H. HENRY, B. S., *Assistant Chemist.*
H. BENTON, M. S., *Assistant Agriculturist.*
B. H. RAWL, B. S., *Assistant Dairyman and Animal Husbandman.*
J. S. PICKETT, *Foreman.*
JOHN N. HOOK, *Secretary and Librarian.*

*Engaged in Fertilizer Analyses.

CLEMSON COLLEGE, S. C., December 1, 1903.

Hon. D. C. Heyward, Governor of South Carolina.

Sir: I have the honor to submit herewith the Sixteenth Annual Report of the South Carolina Agricultural Experiment Station, in accordance with the requirements of an Act of Congress approved March 2, 1887, for the Establishment of Agricultural Experiment Stations in connection with the Colleges of the several States, organized under the provisions of an Act approved July 2, 1862.

Respectfully submitted.

P. H. MELL,
President.

THE SOUTH CAROLINA EXPERIMENT STATION IN ACCOUNT WITH THE UNITED STATES APPROPRIATION, 1902-1903.

DR.

To Receipts from the Treasurer of the United States as per appropriation for fiscal year ended June 30, 1903, as per act of Congress approved March 2, 1887 ..... $15,000 00

CR.

		Abstract.	
By Salaries	1		$8,579 76
Labor	2		2,244 55
Publications	3		935 13
Postage and stationery	4		159 58
Freight and express	5		227 85
Heat, light, water and power	6		101 42
Chemical supplies	7		378 90
Seeds, plants, and sundry supplies	8		298 17
Fertilizers	9		136 38
Feeding stuffs	10		84 47
Library	11		194 66
Tools, implements and machinery	12		121 65
Furniture and fixtures	13		58 60
Scientific apparatus	14		75 10
Live stock	15		227 65
Traveling expenses	16		574 54
Contingent expenses	17		15 00
Buildings and repairs	18		586 59
Balance			
Total			$15,000 00

We, the undersigned, duly appointed Auditors of the corporation, do hereby certify that we have examined the books and accounts of the Treasurer of the South Carolina Experiment Station for the fiscal year ended June 30, 1903; that we have found the same well kept and classified as above, and that the receipts for the year from the Treasurer of the United States are shown to have been $15,000.00, and the corresponding disbursements $15,000.00, for all of which proper vouchers are on file and have been by us examined and found correct, thus leaving no balance.

And we further certify that the expenditures have been solely for the purposes set forth in the act of Congress approved March 2, 1887.

(Signed) R. W. SIMPSON,
[SEAL.] M. L. DONALDSON,
Auditors.

Attest:
P. H. E. SLOAN,
Custodian.

SOUTH CAROLINA AGRICULTURAL EXPERIMENT STATION, 1903.

SUPPLEMENTARY STATEMENT.

[This supplementary statement, while not required by law, is desired as an aid in interpreting the account rendered for the United States appropriation. While it will be more useful if made in conformity with the schedule fixed for that appropriation, if this is not practicable such a summary of receipts and expenditures from the sources indicated below as can be conveniently prepared from the books of the station may be substituted. Whenever practicable, it should be for the fiscal year ended June 30.]

	State.	Local Community.	Individuals.	Fees.	Farm Products.	Miscellaneous.	Total.
DR.							
To Receipts from other sources than the United States for the year ended.	$....	$....	$....	$....	$....	$....	$1,687 63
CR.							
By Salaries	$....	$....	$....	$....	$....	$....	.....
Labor	.....	.....	.....	.....	.....	.....	202 05
Publications	.....	.....	.....	.....	.....	.....	.....
Postage and stationery	.....	.....	.....	.....	.....	.....	.....
Freight and express	.....	.....	.....	.....	.....	.....	4 17
Heat, light, water and power	.....	.....	.....	.....	.....	.....	1 16
Chemical supplies	.....	.....	.....	.....	.....	.....	.....
Seeds, plants, and sundry supplies	.....	.....	.....	.....	.....	.....	17 58
Fertilizers	.....	.....	.....	.....	.....	.....	.....
Feeding stuffs	.....	.....	.....	.....	.....	.....	82 58
Library	.....	.....	.....	.....	.....	.....	.....
Tools, implements, and machinery	.....	.....	.....	.....	.....	.....	42 85
Furniture and fixtures	.....	.....	.....	.....	.....	.....	9 00
Scientific apparatus	.....	.....	.....	.....	.....	.....	14 30
Live stock	.....	.....	.....	.....	.....	.....	413 26
Traveling expenses	.....	.....	.....	.....	.....	.....	.....
Contingent expenses	.....	.....	.....	.....	.....	.....	.....
Buildings and repairs	.....	.....	.....	.....	.....	.....	3 40
Balance	.....	.....	.....	.....	.....	.....	897 28
							$1,687 63

Report of the Vice-Director and Agriculturist.

CLEMSON COLLEGE, S. C., December 10, 1903.

Dr. P. H. Mell, President and Director.

Dear Sir: I have the honor of presenting the following report of the work of the South Carolina Experiment Station during the fiscal year ending June 30, 1903:

AGRICULTURAL DIVISION.

The results of artificially cross-breeding cotton have proved eminently satisfactory. Some of these new varieties are sufficiently well established in fixedness of type to be distributed in small quantities for trial in other parts of the State. Experiments were continued with grasses and legumes, with varieties of wheat, varieties of peas, etc. Experiments were made with different sources and forms of potash to test their effects upon the burning quality of tobacco.

Exhaustive experiments were made with sorghum. These will be repeated to secure average results in different seasons.

COOPERATION WITH UNITED STATES DEPARTMENT OF AGRICULTURE.

Comparison of different varieties of corn in triplicate in cooperation with the Division of Plant Industry of the United States Department of Agriculture.

Growing truffle oaks for the same division was continued.

Specimens of three breeds of pure-bred swine have been secured for comparison *inter se* and for comparison of their crosses as pork producers. Growing crops to be harvested by hogs has been continued. Unfavorable seasons through the entire growing season militated against all experiment work. Assistant Prof. Benton and Mr. J. S. Pickett, foreman of experiment grounds, have rendered valuable and efficient service.

REPORTS OF CHIEFS OF DIVISIONS.

Dr. G. E. Nesom, Veterinarian, has submitted the following report of his work, which I present entire.

REPORT OF VETERINARIAN.

Prof. J. S. Newman, Vice-Director.

Sir: The following report of the work of the Veterinary Division for the year ending June 30, 1903, is respectfully submitted.

Diseases of Horses.—Glanders in horses and mules has prevailed in several counties, but most of the outbreaks have been small, involving from one to ten animals. A number have been tested with mallein, and the reacting animals that showed marked physical signs of the disease were killed. The records of the tests with notes on the outbreaks have been preserved, and will be issued in bulletin form at some future time.

Leuco-encephalitis or cerebro-spinal meningitis (a form of the so-called "staggers") has prevailed to an alarming extent. It was worst in the late summer and fall, continuing up to about March. It was not limited to any special part, but occurred in nearly half of the counties of the State. Numerous visits were made to investigate outbreaks, but unfortunately in most cases the animals were dead, and the carcasses disposed of on the arrival of the inspectors. As the owners generally had not made careful observations of the symptoms, it was not until numerous post mortem examinations had been made, and the brains carefully studied, that the disease was positively diagnosed. Several of the brains were sent to Washington and examined by Dr. John R. Mohler, Pathologist of the Bureau of Animal Industry. This division was greatly aided in the work by his cooperation and assistance. The cause of the disease seemed to be the indiscriminate use of damaged foods, such as decayed corn and moldy hay.

No accurate estimate can be placed on the damage to horse owners in the State from this disease, but from reports on file in this office, it certainly was not less than $10,000 during six months—September 1, 1902, to March 1, 1903.

As no funds were available for the work, no investigations were made further than to diagnose the disease and warn the owners against the further use of the feed stuffs which seemed to be the cause. It may not be out of place to add that this disease has prevailed all along the Atlantic and Gulf coasts

from New York to Texas for fifty years, and has at times caused serious damages in all the States of this region. Very little has been done toward investigating its nature, cause and prevention.

Diseases of Cattle.—Texas fever has been given more attention than any other disease. In the fall when beef cattle began to move to the feeding pens of this State, there occurred several outbreaks of the disease among North Carolina and Tennessee cattle shipped to the middle and lower portions of this State. The bulk of them were raised in the mountains, not many miles above the quarantine line, which marks the northern boundary of the tick-infested section.

They were therefore subject to the fever, and as a result of bad management in shipping some of them became infested with ticks.

Practically all that contracted the disease died, and the loss was something like $4,000.

Such outbreaks clearly show that southern-raised cattle are no more immune to the disease than northern cattle, if they have not actually carried ticks at some time in their lives.

Inoculation.—As planned, a carload consisting of thirty-two head of northern cattle were shipped to the station in October, 1902. They consisted of nineteen registered bulls and heifers under two years old and thirteen high-grade yearling heifers.

Reactions were perfect, the cattle were shipped to their owners and up to the end of the time this report includes all were doing well except one yearling shorthorn bull, which is reported to have died from Texas fever about ninety days after shipment.

In February and March this division inoculated sixty-two head of grade yearling Shorthorn, Hereford and Aberdeen Angus cattle shipped to Hicklins, Rock Hill and Batesburg. The reactions were excellent and all of the cattle seemed to have been protected when exposed to ticks.

Two or three deaths among them are reported as resulting from scours and other causes than Texas fever.

The total number of cattle inoculated up to date is 212 head, and the death rate among them from Texas fever during and

after inoculation has been less than two per cent; while the death rate among northern cattle similarly exposed but not inoculated is generally over fifty per cent.

Hog Cholera.—During the fall and winter this disease appeared in several parts of the State. In several cases the infection could be traced directly to shipments of hogs from East Tennessee. This disease is a serious menace to the hog-raising industry of the State, and so far nothing of importance could be done to check its ravages except to visit sections where outbreaks actually existed, quarantine the infected farms and recommend sanitary measures.

Publications.—During the summer of 1902 bulletin No. 72, "Texas Fever, Part I," was issued, giving a general account of the disease. A number of circular letters and newspaper articles were written on special subjects where bulletins would not serve the purpose. "Texas Fever, Part II—Inoculation," is now in course of preparation.

Respectfully submitted,

G. E. NESOM,
Veterinarian.

December 10, 1903.

The time of both Veterinarian and Entomologist is so much occupied with field work required by State law that systematic investigation in their respective lines is seriously interrupted.

REPORT OF THE ENTOMOLOGIST.

Prof. J. S. Newman, Vice-Director South Carolina Experiment Station.

Sir: During the latter part of March, at the request of representative men and by order of the Department, I visited Darlington and adjoining counties to aid the farmers in fighting the grain louse *Nectarophora avenae* Fabr., which had appeared in the oat fields in unusual numbers. During my first day's study in the field, I discovered that the natural enemies of the louse had increased to such a degree that, if remedial measures were discontinued, the parasitic and predaceous

insects would check the increase of the louse more effectively than any artificial means that could be devised. I announced this at once to save further expense to the farmers, who, in many cases, were broadcasting lime and calcined marl—insecticides, which at their best could only destroy a small percentage of the lice. The results of this field work are reported in a bulletin which is now being prepared.

In cooperation with the Bureau of Chemistry, United States Department of Agriculture, I have conducted spraying experiments for the determination of the amount of arsenious oxid in paris green that can be endured by the foliage of peach, plum, pear and apple. The notes on this work have been forwarded to the proper authorities.

The study of the Boll Worm, *Heliothis armiger,* Huebner, which was being conducted under the direction of the Division of Entomology, United States Department of Agriculture, for the purpose of assisting in mapping out the number of broods and time of appearance of this insect throughout the cotton belt, was discontinued on account of the interruption caused by the Institute work. I refer to the cause of the discontinuance of this work, believing that if brought to your notice an effort will be made to prevent its occurrence again, as such interruptions seriously interfere with the solution of any entomological problem.

Through the State Horticultural Society, the Institutes and correspondence (the latter of which without clerical help is becoming very burdensome), I have been enabled to present in a popular way the economic bearing of entomology.

The unexpected presence of the Mexican Cotton Boll Weevil in Louisiana has caused such uneasiness in South Carolina that the greater part of my correspondence since early August has been upon this insect. Insects of all kinds found upon cotton, especially the boll worm, have been received for identification, but no specimens of the weevil, except a half dozen which were received from a South Carolinian who had imported them from Texas. Our people should be warned against such a practice, and to reach all who may be tempted to do likewise I have prepared for the State press an illustrated article on this pest, to be published in early spring.

In conclusion, I wish to emphasize my recommendations of last year relative to suitable quarters for the study of the life histories of injurious insects. Yours respectfully,

CHAS. E. CHAMBLISS,

December 9, 1903. Entomologist.

REPORT OF THE HORTICULTURIST.

Prof. J. S. Newman, Vice-Director.

Sir: I respectfully submit the following report of the Horticultural Division of the Station for the year ending June 30, 1903.

We have continued to take notes on the varieties of apples growing in the horticultural grounds, and now have notes on these varieties for the past five years. From these notes we are able to recommend certain varieties that have proven to be best suited to this section of the State.

The following varieties have given good results and are to be recommended:

Winter Varieties—Ben Davis, Yates, Winesap, Shockley, Mangum, Scott's Cluster, Kittagiskee, Stevenson's Winter.

Summer Varieties—Early Harvest, Yellow Transparent, Red June, Julian, Carolina Watson, Hominy, Mrs. Bryan.

Many standard varieties that have not been listed here have been planted; we have also secured several more seedling apples from the mountain section, in addition to those mentioned in my last report. Some of these seedlings are of excellent quality, and the trees vigorous and very productive. These varieties promise to be of much value. They are now being propagated and will be tested in different sections of the State.

Peaches.—Many of the varieties of the peaches tested have proven to be of no value for this section of the State, while others have given good results and are to be highly recommended. Out of sixty varieties only one-third of that number have proven worthy of cultivation. The following list of varieties have proven to be well suited to this section and are highly recommended:

VARIETY OF PEACHES.	
Greensboro	S.-C.
Early Tillotson	F.
Early Louise	S.-C.
Yellow St. John	F.
Mountain Rose	F.
Lady Ingold	F.
General Lee	C.
Stonewall Jackson	C.
Elberta	F.
Thurber	F.
Globe	F.
Chinese Cling	C.
Stump the World	F.
Lemon Cling	C.
Bordeaux	C.
Eaton's Golden	C.
Bilyen's October	F.

Note.—F., Freestone; S.-C., Semi-Cling; C., Cling.

The above list of varieties will furnish ripe fruit continuously from the first of June to the last of October. Some of these varieties frequently rot very badly, but we have been able to prevent this disease by spraying with Bordeaux mixture.

Some of the old trees that have proven worthless have been removed and a young orchard of standard varieties set out. A good many new varieties that have recently been introduced are being tested.

Pecans.—Fifty-five of the seedling pecan trees bore a few nuts this year, and I am sorry to say that not one of these trees has borne fine nuts. No two trees have borne fruit alike; they vary greatly in shape, size and quality. The best nuts produced are only about one-third the size of the standard varieties. From some of these trees it required 192 nuts to make one pound, and the best seeding tree that bore nuts required 80 to the pound, while it requires only from 25 to 35 nuts of the best varieties. This goes to show that the pecan varies from seed equally as much as the peach, and it is there-

fore necessary, if fine nuts are desired, that some standard varieties be either budded or grafted on the seedling.

Grapes.—The variety vineyard bore no fruit this year on account of the freeze last spring, which killed all the fruit while in bloom. This is the first year the grapes have failed to bear a full crop.

The vines are in good condition, and I hope to have eighty-four varieties on exhibition next summer during the Institute.

Variety and culture tests have been continued with the following vegetables: Celery, cabbage, cauliflower, tomatoes, onions, canteloupes, eggplants and peppers.

The variety and culture tests have also been continued with blackberries, raspberries and strawberries.

Irish Potatoes.—The experiments we have had under way for the last three years with potatoes have been continued.

1. Comparison of northern, western and southern grown seed for planting in spring and fall.
2. Comparison of fall, winter and spring planting.
3. Different depths of planting and culture.
4. Methods of keeping spring and fall crops.
5. Test of varieties.
6. Treatment of tubers before planting to prevent scab.
7. Spraying for insect enemies and diseases of the potato.

Very respectfully,

C. C. NEWMAN,

December 5, 1903. Horticulturist.

REPORT OF THE BOTANIST AND BACTERIOLOGIST.

Prof. J. S. Newman, Vice-Director South Carolina Experiment Station.

I beg to submit the following report:

Correspondence.—During the year ending September 1, 1903, 1,580 official letters have been written by the Botanist. As there is no stenographer at the service of the station officials, anyone familiar with the details of correspondence can readily calculate how much time and effort have been consumed in the merely mechanical part of this work, aside from

the technical studies necessary in order to answer the questions. This correspondence has been principally concerned with the identification of forage plants and seeds, the identification and treatment of plant diseases, within the State; inquiries from outside regarding agricultural and botanical facts within the State; requests from teachers for identification of plants, and for facts and literature bearing upon nature study. This last class of correspondence is largely on the increase, and I recommend that some general action be taken to supply such information by issuing "nature study bulletins," as is done in many States, or by some other means. As the library of this division is very limited, containing few of the books necessary for the identification of any but the commonest forage plants and fungous diseases, it is often necessary to secure the loan of literature from the libraries of other stations, or the United States Department of Agriculture, before letters can be answered. This sometimes involves a delay of a month or six weeks, which must be very irksome to the correspondents.

Herbarium.—Every plant or disease, once identified, is preserved in the herbarium, which thus is becoming an invaluable reference collection, in teaching as well as in the work of the station. It is my purpose to place in the herbarium a specimen of every plant of economic value which grows in the State, as well as, in time, to make it representative of the native flora. Arrangements are being perfected with a number of amateur collectors in the State whereby they, in return for various assistance, will deposit duplicates of their collecting in the herbarium.

Student Labor.—In the herbarium work especially, and in other lines, student assistants have been employed as heretofore. The work has been very satisfactory. Especial mention should be made of the excellent service rendered by Mr. T. B. Young of the Class of 1903, now in the employ of the United States Department of Agriculture, and by Cadet H. W. Barre of the present Junior Class.

Investigations.—In my last report I stated that my lines of investigation were (1) a contagious poultry disease ("limber neck," so called), (2) leaf spot of tobacco ("frog-eye"), and (3) "blast" of rice.

Investigations of the poultry disease were continued through the year, and while they were far from complete when work ceased, the following provisional results were arrived at. The disease is an entero-hepatitis, the most characteristic post mortem symptoms being marked inflammation of the intestinal tract, with degeneration and congestion of the liver tissue. Though apparently contagious the disease is not bacterial. The occurrence of the disease is invariably associated with the prevalence of a certain fly, which lays its eggs in the feathers. Experiments indicated that fowls kept from this fly did not contract the disease, whereas those kept under exactly the same conditions, but not protected from the flies, contracted the disease and died. Hence the indications are that the disease is of the same general aetiology as malaria, yellow fever and Texas fever of cattle; but the experiments were too few in number to warrant the drawing of absolute conclusions. The disease is popularly confused with several other poultry diseases; not more than sixty per cent. of all the poultry brought to the laboratory for post mortem examination had died from this distinct disease. This investigation ceased, of necessity, with the abolition of the poultry division.

Laboratory studies of the spot diseases of tobacco were carried on for several months, then discontinued; as the entire question of tobacco diseases in this State has been taken up by the United States Department of Agriculture.

Investigations of the rice blast and other rice diseases have been my principal work. In this station the blast is by all odds the most serious rice disease, and is even threatening the existence of the rice industry in certain localities. One bulletin on this subject has already been issued by this station. Both of my predecessors investigated the disease, but as they left before arriving at final conclusions their work is practically lost. My results so far indicate that the disease is of fungous origin, and that it can be controlled by the same methods that have been employed with cotton wilt, i. e., selection of seed from immune stalks.

Greenhouse.—It is no exaggeration to say that my working capacity would be doubled, so far as plant diseases are concerned, if I had access to a greenhouse. With this addition to

my equipment, practical work in inoculation and immunity studies could be carried on as well in the winter as in the summer. For lack of this it is impossible to even attempt the study of the diseases of our staple crop, cotton, or the diseases of many truck crops, such as asparagus, tomatoes and melons.

Seed Testing.—Work has been in progress in the division for about six months on the question of the purity and vitality of the seed supply of the State, especially grass, grain and clover seed.

Diseases of Plants.—As a full account of the plant diseases that have appeared in the State during the past year is being prepared for publication in the Yearbook of the United States Department of Agriculture, I purposely omit that account here.

Institutes.—During the summer I lectured at seven farmers' institutes through the State, and I participated in the Institute held at Clemson.

Proposed Work.—For the coming year I shall concentrate my efforts upon the disease of rice, especially the blast; shall continue the seed examination, investigate the whole question of storage and keeping qualities of sweet potatoes.

Bulletins.—Three bulletins are in preparation on the following subjects: Seed purity and vitality, the commonest plant diseases and their treatment, sanitary conditions on the farm. The last will very shortly be ready for press.

Respectfully submitted,

HAVEN METCALF,

Botanist and Bacteriologist.

December 4, 1903.

REPORT OF DAIRY AND ANIMAL HUSBANDRY.

Prof. J. S. Newman.

Dear Sir: I beg to submit the following report of the Division of Animal Husbandry and Dairying.

In the annual report of last year it was announced that an ideal dairy barn was under way of construction. Since that time the building has been completed and is now occupied by a herd of pure-bred cattle consisting of Jerseys,

Ayrshires, Devons and Shorthorns. As it was impossible, with the limited means at hand, to buy many costly animals, it was the policy of the management to buy a few select cows and a choice bull of each of the above named breeds and begin breeding. The cattle are all in good condition and have been bred successfully. We have at present two small pastures and a number of paddocks under fence and partly sodded, but we hope during this winter to enclose two more pastures and to continue sodding and sowing grass, so that when our herds reach the desired size we will have ample first-class pasturage for them and will also be able to show what kind of pasture can be made on our "worn out" hills.

Owing to our limited number of cattle and to a lack of their uniformity, no experiments have so far been conducted. An experiment to determine the effects of long and continuous feeding of cottonseed meal to cattle (milch cows) has been planned and will be begun in a few days. It is believed by some authorities that cottonseed meal when fed to milch cows in large quantities for a long period of time will produce abortion, barrenness and other abnormal troubles. It is, therefore, the object of this experiment to determine, if possible, what injurious effects will result and the extent of such injuries.

Four healthy grade cows of average constitution and size have been procured, all of which have proven themselves to be sure breeders. They will be fed heavily on cottonseed meal rations throughout all periods of pregnancy and lactation. We hope to be able to continue this experiment indefinitely, so as to obtain data that will enable us to either advocate or condemn the extensive feeding of this very common foodstuff.

We hope by spring to be able to conduct some feeding experiments with a group of pure-bred cattle. This cannot be determined until we find what their condition will be at that time.

A small exhibit of our cattle was made at the State Fair last fall, and while there our surplus bulls were sold. We hope to repeat this exhibit next year and again offer for sale a fine lot of young pure-bred bulls.

In our dairy building one room is now being equipped with modern hand machinery for milk separation and butter

making, and we wish here to express thanks to the DeLaval Separator Company, the Vermont Farm Machine Company, and to Mr. P. M. Sharples for the use of the hand separators they have each placed with us for this season.

Work is now in progress on a bulletin that will demonstrate the importance of the milk-sheet, the milk scales and the Babcock test, and give sufficient explanation of how the Babcock test is made, so as to enable any farmer to test each cow in his herd and determine whether or not she is a profitable animal.

Respectfully submitted,

B. H. RAWL,

Acting Dairyman and Animal Husbandman.

The chiefs of Divisions are all doing satisfactory work as far as their facilities permit. We are undertaking more work than the means at command justify.

FARMERS' INSTITUTES.

During the last spring and summer forty local Institutes were held, with an aggregate attendance of about 10,000. The attendance on the State Institute, held at the College, was estimated at 1,500. Seven members of the Agricultural Department participated in the exercises of these Institutes.

COAST EXPERIMENTS.

In accordance with the orders of the Board of Trustees, experiments have been conducted with asparagus and sea island cotton on James Island, and with rice on Cooper River. Illustrative work with grasses and forage plants has been done on a plot originally embraced in the exposition grounds. The latter experiments have already stimulated the farmers of that section to increased planting of forage crops. A report of progress will be made in bulletin form.

BULLETINS.

Nine bulletins were issued during the fiscal year ending June 30, 1903. There is a mass of data, the results of experi-

ments, awaiting preparation. Strenuous effort will be made to have this material prepared in the near future. Popular bulletins will also be prepared on a number of subjects in which much interest is manifested and about which numerous inquiries are received. Respectfully submitted,

J. S. NEWMAN,
Director Agricultural Department.

Report of Chemist.

Clemson College, S. C., September 3, 1903.

President P. H. Mell, Director.

Sir: I respectfully submit the following report of the Chemical Department of the Station for the year ending June 30, 1903.

The work on the *Rotation Experiment*, referred to in previous reports, was completed last year, and the results have this year been published in Bulletin 79.

There have also been published two technical bulletins, one on "The Standardization of Sulphuric Acid," Bulletin 77; the other on "The Nature, Determination and Distribution of the Pentosans in the Sea Island Cotton," Bulletin 78.

These investigations were made and the bulletins prepared by Mr. F. S. Shiver, who is now writing up the results of his study of the *Tea Industry* in South Carolina and is also engaged in a study of the *Tobacco Industry* in this State.

The following work has also been done during the year: Analyses of four samples of rice soils, two samples of sea island cotton soils and two samples of asparagus soils for Col. J. S. Newman, Vice-Director, in charge of the Coast Region Experiments; two samples of rice soils for planters on the Combahee River; five samples of cottonseed meal; one sample of sugar beets and two samples of long-leaved pine ashes for citizens of the State. It is worthy of remark that the *rice soils* were very acid and that they contained in addition to the large quantity of organic acids considerable quantities of soluble sulphates, notably aluminum and iron sulphates, as well as iron sulphide.

The application of lime was recommended in the case of these soils. The soil work was done by Messrs. Shiver and Henry; the other analyses were made partly by these gentlemen and partly by Messrs. McDonnell and Robertson.

STATE ANALYTICAL WORK.

Following is a report of the work on commercial fertilizers, drinking water, minerals, ores, etc., done at the Station under the direction of the Fertilizer Control Committee of the Board of Trustees:

SUMMARY.

	Year ending June 30, 1902.	Year ending June 30, 1903.
Official samples of fertilizers	313	340
Farmers' samples of fertilizers	38	52
Waters	73	70
Limestone and Marls	6	0
Ores and Minerals	18	32
Clays and sands	4	7
Miscellaneous	5	3
Clays from State Geologist	—	20
	457	524

OFFICIAL SAMPLES OF FERTILIZERS.

The number of samples analyzed this year is 340. The analyses are given in full in *Bulletins 80 and 82 of this Station.*

CLASSIFICATION.

	1902.	1903.
Complete fertilizers	141	139
Acid phosphates	45	51
Acid phosphates with potash	51	55
Cottonseed meals	49	69
Kainits	16	15
Nitrate of soda	3	2

	1902.	1903.
Muriate of potash	4	2
Sulphate of potash	1	1
Nitrate of soda with potash	1	1
Ground fish	1	1
Sulphate of ammonia	0	1
Dried blood	0	1
Miscellaneous	1	2
Total	313	340

DEFICIENT SAMPLES.

Of the 340 samples analyzed *23 were deficient under the law.*

In addition to these there were 91 samples which fell below guarantee in one or more constituents, as follows:

In available phosphoric acid	21
In available phosphoric acid and ammonia	2
In available phosphoric acid and potash	3
In potash and ammonia	7
In ammonia	24
In potash	34
Total	91

The extent to which they fell below guarantee is shown in the following table:

	Below Guarantee—Per Cent.				
	.0-.1	.1-.25.	.25-.50.	.50-1.	1 & Over.
In available phosphoric acid	6	7	7	4	1
In ammonia	8	12	12	1	0
In potash	10	17	12	6	0
Total	24	36	31	11	1

The number of samples deficient under the law is much larger than usual, 23 out of 340 opposite 4 out of 313 last year, 12 being the largest number of such deficiencies in any season during the five preceding years.

The number of samples falling below guarantee in one or more constituents, though not deficient in accordance with

law, is also unusually large, there being 91 samples this year opposite 72 last year, 72 being the highest number reached during the last five years. *To the condition of things indicated by this large number of deficiencies, the attention of the Fertilizer Control Committee is respectfully directed.*

AVERAGES OF ANALYSES.

	1902. Per Cent.		1903. Per Cent.	
	Found.	Guaranteed.	Found.	Guaranteed.
ACID PHOSPHATES.				
Soluble phosphoric acid	10.63	.....	9.77	.....
Reverted phosphoric acid	3.48	.....	3.97	.....
Available phosphoric acid	14.11	13.07	13.74	13.23
Insoluble phosphoric acid	1.10	.....	1.17	.....
Total phosphoric acid	15.21	.....	14.91	.....
ACID PHOSPHATES WITH POTASH.				
Soluble phosphoric acid	7.03	.....	6.57	.....
Reverted phosphoric acid	4.06	.....	4.37	.....
Available phosphoric acid	11.09	10.04	10.94	10.17
Insoluble phosphoric acid	1.02	.....	1.26	.....
Total phosphoric acid	12.11	.....	12.20	.....
Potash soluble in water	2.55	2.47	2.65	2.67
COMPLETE FERTILIZERS.				
Soluble phosphoric acid	6.85	.....	6.32	.....
Reverted phosphoric acid	2.54	.....	2.70	.....
Available phosphoric acid	9.39	8.28	9.02	8.26
Insoluble phosphoric acid	1.66	.....	1.42	.....
Total phosphoric acid	11.05	.....	10.43	.....
Ammonia	2.84	2.66	2.69	2.55
Potash soluble in water	2.34	2.10	2.42	2.14
COTTONSEED MEALS.				
Available phosphoric acid	2.57	1.47	2.27	1.47
Ammonia	7.93	7.36	8.08	7.14
Potash soluble in water	1.63	1.00	1.48	1.00
KAINIT.				
Potash soluble in water	12.85	12.00	12.92	12.00
MURIATE OF POTASH.				
Potash (equivalent)	50.54	48.25	50.25	49.00
SULPHATE OF POTASH.				
Potash	49.10	45.00	49.32	50.00
SODIUM NITRATE.				
Ammonia (equivalent)	19.03	18.33	19.15	18.00

The available phosphoric acid and potash in cottonseed meal were guaranteed in only nineteen samples, but these ingredients were determined in all cases.

The following table will prove interesting as showing the yearly averages of fertilizer analyses from the time the Board of Trustees of this College took charge of the Station work down to the present time:

YEARLY AVERAGES OF ANALYSES FROM 1891 TO 1903, INCLUSIVE

Season.	Acid Phosphates.		Acid Phosphates with Potash.			Complete Fertilizers.				Cottonseed Meals.				Kainits.		Muriate of Potash.		Nitrate of Soda.	
	Number of Samples.	Available Phosphoric Acid, Per Cent.	Number of Samples.	Available Phosphoric Acid, Per Cent.	Potash Soluble in Water, Per Cent.	Number of Samples.	Available Phosphoric Acid, Per Cent.	Ammonia, Per Cent.	Potash Soluble in Water, Per Cent.	Number of Samples	Available Phosphoric Acid, Per Cent.	Ammonia, Per Cent.	Potash Soluble in Water, Per Cent.	Number of Samples.	Potash, Per Cent.	Number of Samples.	Potash, Per Cent.	Number of Samples.	Ammonia, Per Cent.
1890-1. . . .	49	13.02	19	11.84	1.65	173	9.34	2.68	1.96	30	.....	8.37	.....	21	12.75	1	51.96	1	19.22
1891-2. . . .	29	12.92	16	11.50	1.49	112	8.83	2.80	1.95	25	.....	8.21	.....	18	12.51	.....	.....	1	18.63
1892-3. . . .	48	12.32	26	11.63	1.22	150	9.00	2.91	1.65	20	2.62	8.40	1.32	20	12.05	.....	.....	.....	.....
1893-4. . . .	46	13.24	22	12.01	1.51	132	9.27	2.53	1.79	22	2.45	8.64	1.69	17	12.37	.....	.....	.....	.....
1894-5. . . .	46	13.55	15	12.09	1.66	87	9.42	2.55	1.77	33	2.58	8.19	1.66	19	12.30	.....	.....	.....	.....
1895-6. . . .	42	13.43	26	11.99	1.39	115	9.31	2.64	1.86	34	2.57	8.45	1.61	16	12.45	.....	.....	.....	.....
1896-7. . . .	59	13.61	34	12.06	1.61	117	9.55	2.70	1.91	40	2.53	8.69	1.64	22	12.44	.....	.....	.....	.....
1897-8. . . .	63	13.67	50	11.54	2.06	141	9.15	2.70	1.93	39	2.37	8.39	1.58	20	12.68	.....	.....	1	19.23
1898-9. . . .	73	13.74	68	11.77	1.99	134	9.32	2.73	2.21	40	2.76	8.25	1.75	14	12.78	2	51.93	2	18.96
1899-1900 . .	73	13.58	63	11.58	2.00	124	9.50	2.73	2.13	52	2.27	8.73	1.63	8	12.73	4	50.95	3	19.01
1900-1. . . .	56	14.00	55	11.49	2.65	139	9.40	2.87	2.47	60	2.38	8.55	1.54	12	12.61	2	48.92	3	18.96
1901-2. . . .	45	14.11	51	11.09	2.55	141	9.39	2.84	2.34	49	2.57	7.93	1.63	16	12.85	4	50.54	3	19.03
1902-3. . . .	51	13.74	55	10.94	2.65	139	9.02	2.69	2.42	69	2.27	8.08	1.48	15	12.92	2	50.25	2	19.15

In this table the ammonia yielded by the nitrogen in fertilizers is given instead of the nitrogen itself, as in the trade goods are still bought and sold on the ammonia basis. The per cent. of nitrogen is easily calculated by remembering that fourteen-seventeenths of the weight of ammonia is nitrogen.

The table shows that during the last few years there has been a general tendency to an increase in the available phosphoric acid in acid phosphates, and a decided increase in the proportion of potash, both in the mixtures of acid phosphates with potash and in complete fertilizers.

GRADES.

In the following table the number of acid phosphates and complete fertilizers of each grade, according to guarantee, is placed side by side with the number found by analysis to belong to that grade, fertilizers having commercial values equal to those of schedule grades being classed in those grades:

		High.		Standard		Low.	
		Claimed.	Found.	Claimed.	Found.	Claimed.	Found.
Complete fertilizers	(139)	45	54	80	78	14	7
Acid phosphates	(51)	43	37	8	11	0	3
Acid phosphates with potash	(55)	25	42	30	9	0	4
Total	(245)	113	133	118	98	14	14

These results are due to the following changes in grade ascertained by analysis:

		Low to Standard.	Standard to High.	Low to High.	High to Standard.	Standard. to Low.	High to Low.	No Change.
Complete fertilizers	(139)	10	8	1	1	4	0	115
Acid phosphates	(51)	0	3	0	8	3	1	36
Acid phosphates with potash	(55)	0	19	0	2	4	0	30
Total	(245)	10	30	1	11	11	1	181

This shows that out of 245 samples, 181 were of the grade claimed for them, 41 were of a higher grade, and 23 of a lower grade than that claimed for them.

Last year out of 237 samples, 178 were of the grade claimed for them, 55 were of a higher grade, and only 4 of a lower grade than that claimed for them.

FARMERS' SAMPLES OF FERTILIZERS.

In addition to the samples collected by the Official Inspectors, there have been analyzed fifty-two samples for individual farmers. As these analyses cannot be made unless the law and the rules of the Department are complied with, farmers are frequently put to unnecessary trouble and expense through failure to write to the Secretary of the Fertilizer Department for instructions before sending on samples for analysis.

WATER.

Seventy samples have been analyzed. Of these, nine were from deep or artesian wells, five of which were flowing. Of the remaining samples some were sent for sanitary examination, others in the belief that they represented mineral waters of great therapeutic value.

ORES, MINERALS AND OTHER SUBSTANCES.

Forty-two specimens have been assayed or analyzed. Attention is specially called to two of these specimens, which came from the tin ore deposits near Gaffney, S. C. This tin ore, as stated in my last annual report, occurs in a bed of red clay. The specimens of the ore, cassiterite, were separated as far as possible from gangue and submitted to assay. They yielded, respectively, 64 per cent. and 69 per cent. of metallic tin. The ore is free from injurious substances, and if found in large quantities will prove of great value.

ANALYSES FOR STATE GEOLOGIST.

There have been made for the State Geologist complete and rational analyses of twenty samples of clay; involving some 250 separate determinations. These analyses were made as provided for in paragraph 14, Section I, Act of the General Assembly, No. 605, approved February 22, 1902.

DISTRIBUTION OF THE WORK.

The analyses of fertilizers were made by Messrs. McDonnell and Robertson, the analyses of water by Messrs. McDonnell and Henry, the analyses and assays of minerals, ores, etc., by Messrs. Robertson and Henry, and the work for the State Geologist was done by Mr. Robertson. In the office I have had the assistance of Dr. Brackett, who, during my absence on College duty in the summer of 1902, was in charge of all the office work of the labaratory.

It is with pleasure that I renew my acknowledgments of the efficient services which these gentlemen have rendered the Department.

Very respectfully,

M. B. HARDIN,
Chief Chemist.

Synopsis of Bulletins.

No. 74, November, 1902. Experiments with Poultry. 6 pages.

No. 75, April, 1903. Cotton Culture. 13 pages.

No. 76, November, 1902. Bermuda Grass. 6 pages.

No. 77, November, 1902. The Standardization of Sulphuric Acid. 7 pages.

No. 78, December, 1902. The Nature, Determination and Distribution of the Pentosans in the Sea Island Cotton. 38 pages.

No. 79, April, 1903. A Rotation Study. 62 pages.

No. 80, April, 1903. Analyses of Commercial Fertilizers. 26 pages.

No. 81, June, 1903. Artificial Incubation of Chickens. 10 pages.

No. 82, June, 1903. Analyses of Commercial Fertilizers. 10 pages.